Elasticity of Actin Networks

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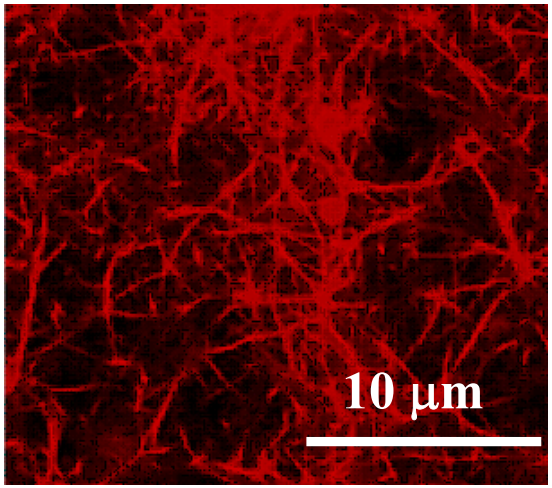
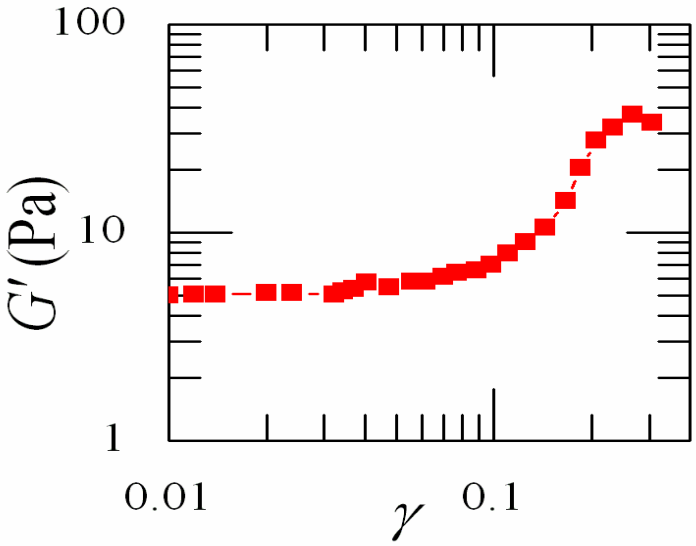
We study the material properties of crosslinked and bundled actin networks. Networks of semi-flexible actin filaments are an essential mechanical component of the cytoskeleton in nearly all eukaryotic cells and is necessary for cell motility, mechanoprotection and division. We study purified actin networks *in vitro* to study the fundamental mechanisms of semi-flexible network elasticity.

By fluorescently tagging individual filaments, we can directly image the actin networks with a confocal microscope, as shown in the image. By imaging, we can directly measure how the bundle thickness and mesh size varies as a function of ABP concentration.

We measure the elasticity of the networks over a wide range of actin and crosslinker concentrations and can directly correlate changes in microstructure to changes in the elastic modulus. Moreover, we find that the elastic modulus is very senstive to the magnitude of the applied strain, γ. Above strains of ~10%, the elastic modulus increases dramatically. The strain dependent elastic response of a typical crosslinked network is shown to the right. Remarkably, both the linear and nonlinear elastic response of the networks can be understood by considering the entropic force-extension of single semi-flexible actin filaments.

The measurements provide insight into the nature of semi-flexible polymer networks that is necessary for engineering biomimetic materials for use in tissue engineering.





Confocal Studies of Colloidal Crystallization
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Brief summary of outreach activities:

Educational:
6 undergraduates currently in the group
11 grad students currently in the group
10 post-docs currently in the group
Note that 4 of my undergrad students, 5 of my grad students, and 3 of my post docs are women.

With Seth Fraden, I have initiated a series of meetings of the soft condensed matter community in the New England area. They have now become an institution in the area. We have our own web page (www.complexfluids.org), and we have meetings at many universities in the region, including UMass Amherst, Brown, Yale, UMass Boston, Boston University, MIT, as well as Brandeis and Harvard. There are typically over 80 participants, most of whom are graduate students and post docs. It is an excellent educational experience for all of them.

Several of the post docs working on my NSF-funded research are funding in part by grants from industry. This ensures that our work has a direct impact on important technology, to help maintain the competitiveness of US industry. It also leverages my NSF support, allowing it to be used to train undergraduate and graduate students. In addition, it ensures that the work we do has a direct practical significance.

The companies we work with include:

Proctor and Gamble

Rhodia USA

Infineum

Colgate-Palmolive

Unilever

Alkermese

Kraft